PATENT ABSTRACTS OF JAPAN

(11)Publication number : **2002-368642**

(43)Date of publication of application : **20.12.2002**

(51)Int.Cl. H04B 1/26
H03L 7/18

(21)Application number : **2001-174197**

(22)Date of filing : **08.06.2001**

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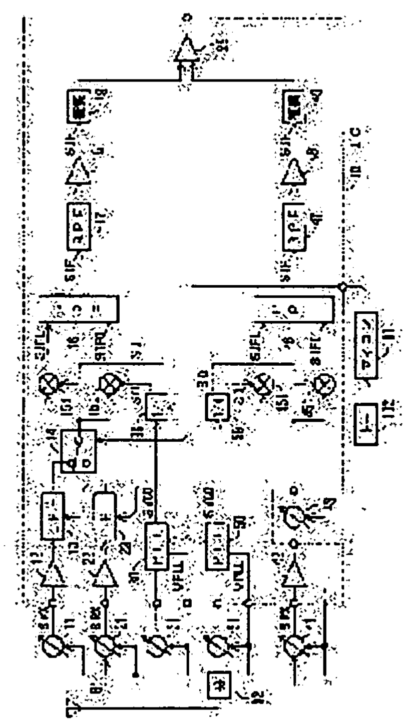
(54) **RECEIVER AND IC**

(57)Abstract:



PROBLEM TO BE SOLVED: To provide a multi-band receiver that enhances characteristics, such as tracking error.

SOLUTION: The receiver is provided with a variable frequency oscillation circuit, a variable frequency divider circuit 39 that applies frequency division to an oscillation signal SVCO of the variable frequency oscillation circuit, and mixer circuits 15I, 15Q, that apply frequency conversion of a received signal SRX into an intermediate frequency signal SIF, by using a local oscillation signal SLO. The variable frequency divider circuit 39 provides its frequency division output to the mixer circuits 15I, 15Q as a local oscillation signal SLO. IN the case of receiving a 1st frequency band, changing frequency division ratio (n) of the variable frequency divider circuit 39 and an oscillation frequency of the variable frequency oscillation circuit revises a reception frequency for the 1st frequency band. In the case of receiving a 2nd frequency band, changing at least the oscillation frequency of the variable frequency oscillation circuit revises a reception frequency for the 2nd frequency band.

LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the schematic diagram showing one gestalt of this invention.
[Drawing 2] It is the schematic diagram showing a part of one gestalt of the circuit of drawing 1 .
[Drawing 3] It is front drawing showing one frequency-related gestalt.
[Drawing 4] It is the property Fig. showing a tracking error property.
[Drawing 5] It is the property Fig. showing a tracking error property.
[Drawing 6] It is the property Fig. showing a tracking error property.
[Drawing 7] It is the schematic diagram showing a part of one gestalt of the circuit of drawing 1 .
[Drawing 8] It is the schematic diagram showing a part of one gestalt of the circuit of drawing 7 .
[Drawing 9] It is the schematic diagram showing other gestalten of this invention.
[Drawing 10] It is the schematic diagram showing a part of one gestalt of the circuit of drawing 9 .
[Drawing 11] It is front drawing showing other frequency-related gestalten.
[Drawing 12] It is the property Fig. showing a tracking error property.
[Drawing 13] It is the property Fig. showing a tracking error property.
[Drawing 14] It is the property Fig. showing a tracking error property.
[Drawing 15] It is the property Fig. showing a tracking error property.
[Drawing 16] It is the schematic diagram showing other gestalten of this invention.
[Drawing 17] It is a schematic diagram for explaining this invention.
[Description of Notations]
10 [-- Adjustable low pass filter,] -- IC, 11 -- An antenna tuning circuit, 12 -- RF amplifier, 13 14 -- A switching circuit, 15I and 15Q -- A mixer circuit, 16 -- Poliphase filter, 17 [-- Antenna tuning circuit,] -- A band pass filter, 18 -- Amplifier, 19 -- A demodulator circuit, 21 22 -- High frequency amplifier, 23 -- An adjustable low pass filter, 29 -- Buffer amplifier, 30 [-- Good variations circumference way,] -- PLL, 31 -- A resonance circuit, 32 -- VCO, 33 At least 34 -- is a phase comparator circuit and 35. -- A reference signal formation circuit, 36 -- Low pass filter, 39 -- A good variations circumference way, 41 -- An antenna tuning circuit, 42 -- RF amplifier, 42 -- An

interstage tuning circuit, 45I and 45Q -- A mixer circuit, 46 -- Poliphase filter, 47 [-- PLL, 51 / -- A resonance circuit, 59 / -- A frequency divider, 61 / -- An antenna, 62 / -- A distributor, 101 / -- A microcomputer, 102 / -- Actuation key] -- A band pass filter, 48 -- Amplifier, 49 -- A demodulator circuit, 50

[Translation done.]

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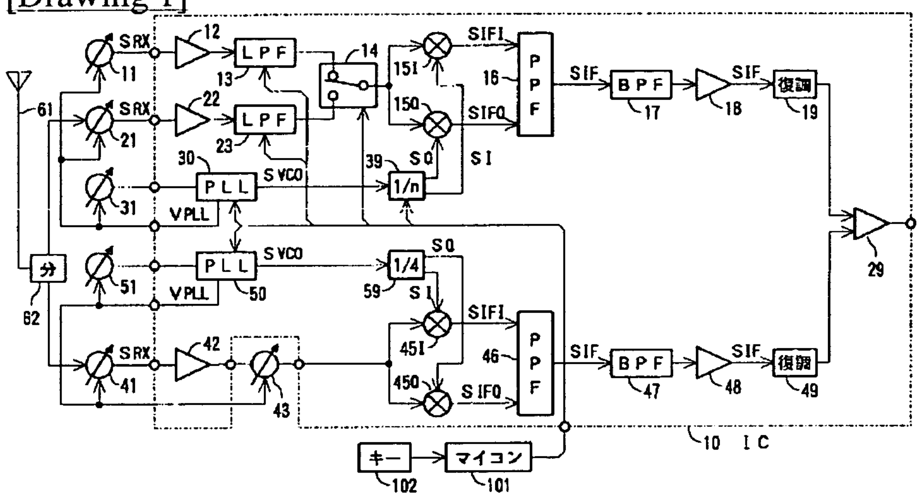
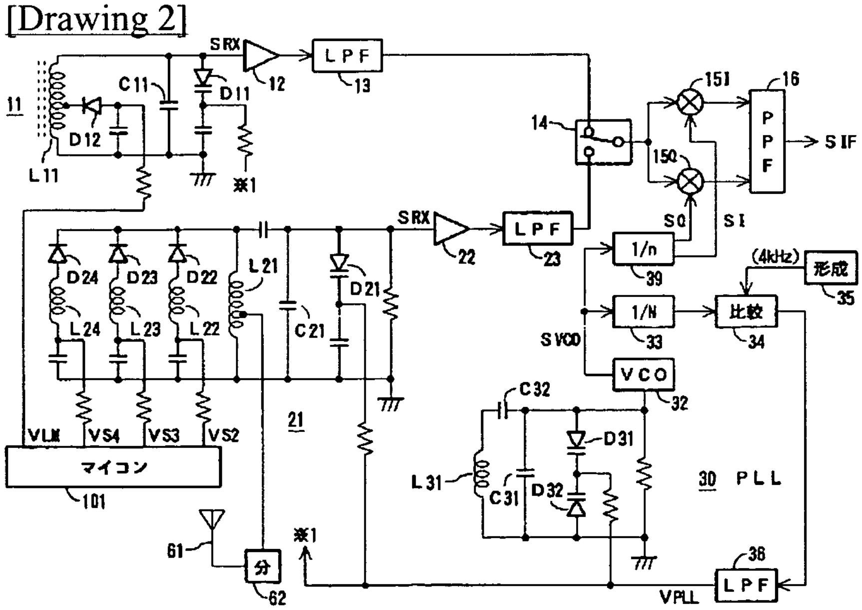
DRAWINGS

[Drawing 1]



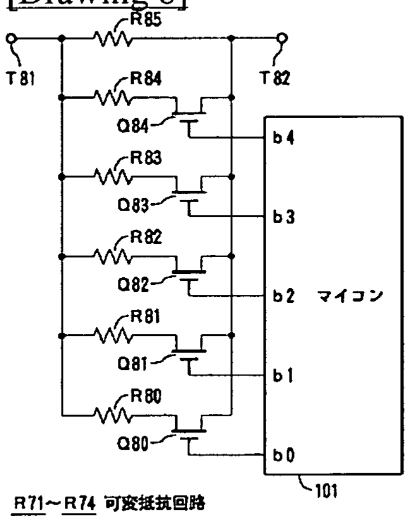
[Drawing 2]



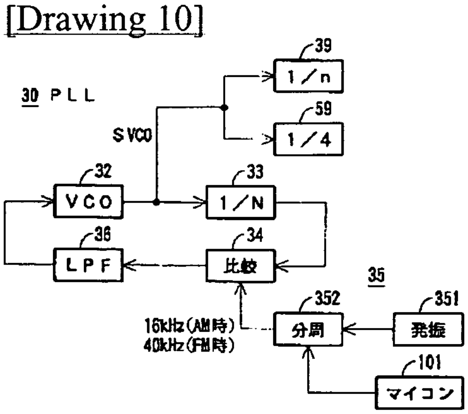
[Drawing 3]

	受信周波数 f RE[kHz]	周波数ステップ [kHz]	N	Nのステップ	発振周波数 f VCO [MHz]	n	局発周波数 f LO [kHz]	f LOの誤差 [Hz]
長波	150		9225	−	36.900	180	205.000	0
	153	9kHz ステップ	9360	−	37.440	180	208.000	0
	162		9873	−	39.492	182	216.989	-11.0
	⋮		⋮		⋮	⋮	⋮	⋮
	513		29394	−	117.576	207	568.000	0
	520		29756	−	119.024	207	574.995	-4.9
中波	522〜1800	9	9232〜29680	144	36.928〜118.720	64	577〜1855	0
短波1	1800〜3750	1	14840〜30440	8	59.360〜121.760	32	1855〜3805	0
短波2	3600〜7500	1	14620〜30220	4	58.480〜120.880	16	3655〜7555	0
短波3	7200〜15000	1	14510〜30110	2	58.040〜120.440	8	7255〜15055	0
短波4	14400〜30000	1	14455〜30055	1	57.820〜120.220	4	14455〜30055	0
FM	76〜108 [MHz]	50	1524〜2164	1	304.8〜432.8	(4)	76.2〜108.2 [MHz]	0

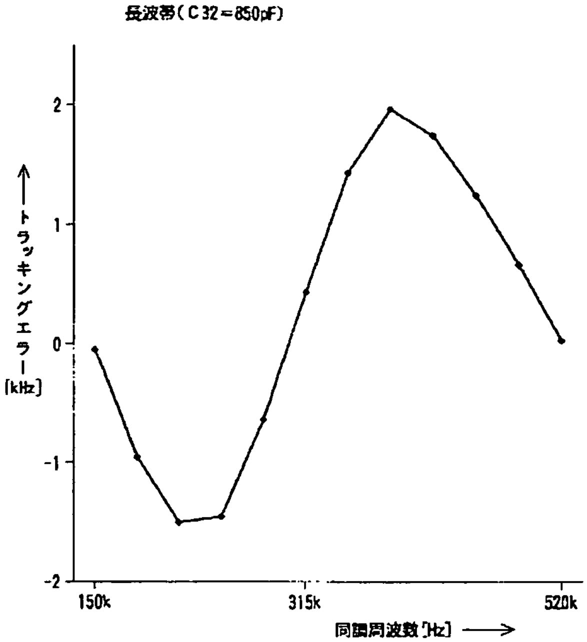
[Drawing 8]



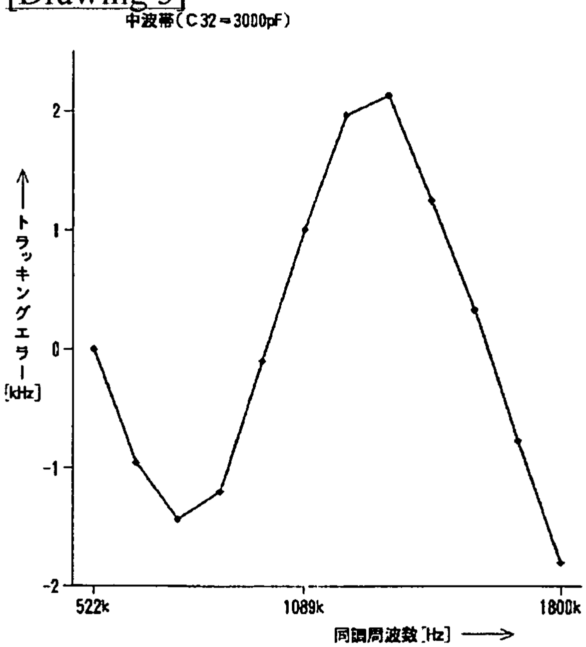
[Drawing 10]



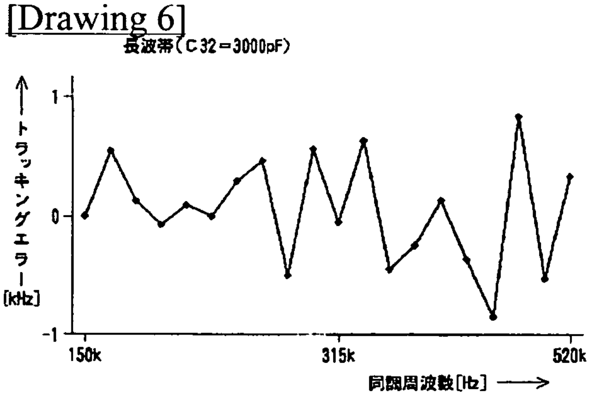
[Drawing 4]



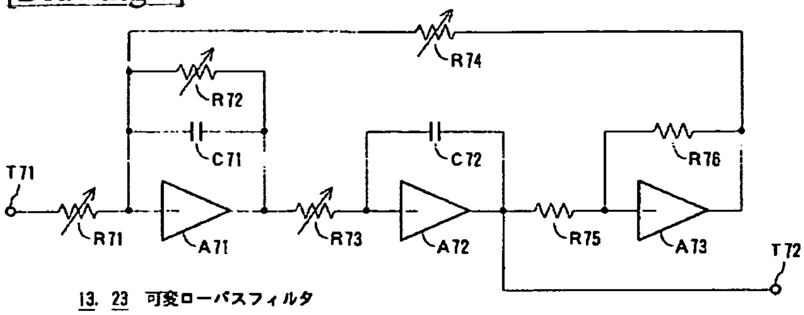
[Drawing 5]



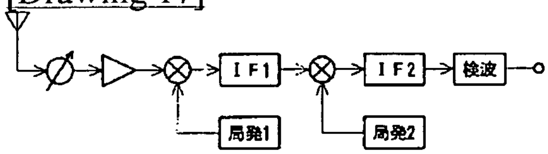
[Drawing 6]



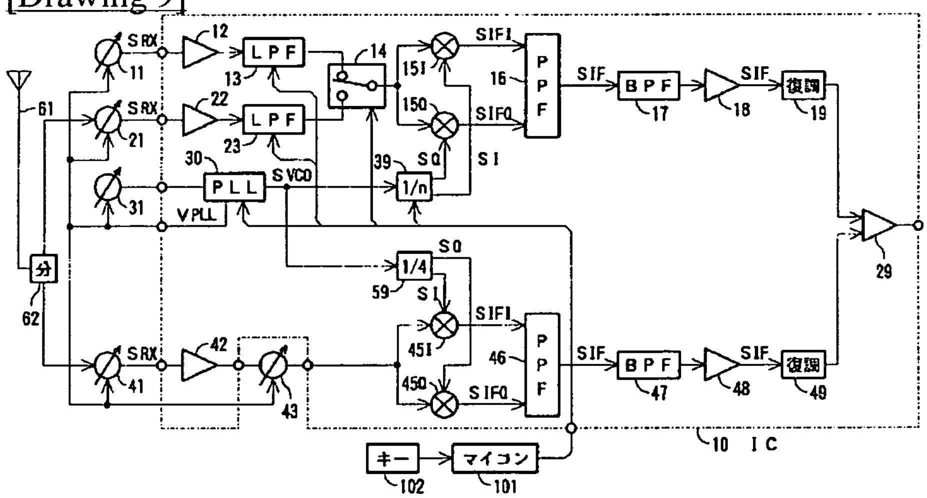
[Drawing 7]



[Drawing 17]



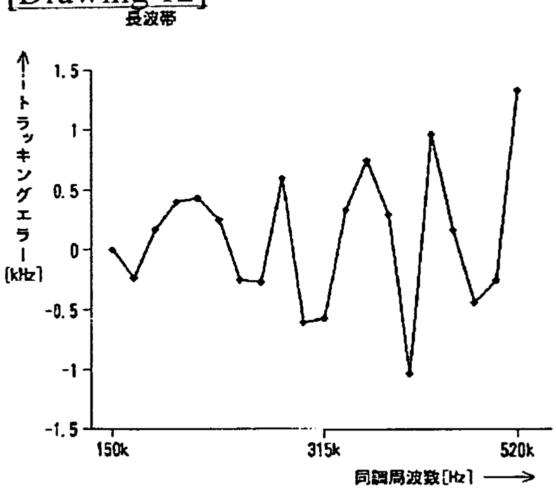
[Drawing 9]



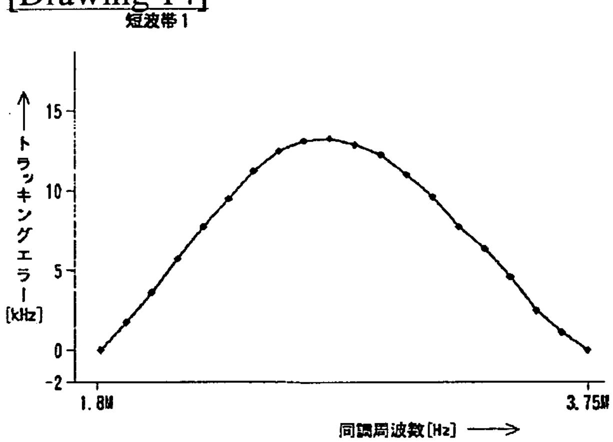
[Drawing 11]

	受信周波数 f RE [kHz]	周波数ステップ [kHz]	N	Nのステップ	発振周波数 f VCO [MHz]	n	局発周波数 f LO [kHz]	f LOの誤差 [Hz]
長波	150		14248	−	227.968	1112	205.0072	+7.2
	153	9kHz ステップ	14352	−	229.632	1104	208.0000	0
	162		14702	−	235.232	1084	217.0037	+3.7
	⋮		⋮		⋮	⋮	⋮	⋮
	513		30814	−	493.024	868	568.0000	0
	520		31050	−	496.800	864	575.0000	0
中波	522	9kHz ステップ	14281	−	228.496	396	577.0101	+10.1
	531		14357	−	229.712	392	586.0000	0
	⋮		⋮		⋮	⋮	⋮	⋮
	1782		30770	−	492.320	268	1837.0149	+14.9
	1791		30921	−	494.736	268	1846.0299	+29.9
	1800		31071	−	497.136	268	1854.9851	-14.9
短波 1	1800～ 3750	1	14840～30440	8	237.440～487.040	128	1855～ 3805	0
短波 2	3600～ 7500	1	14620～30220	4	233.920～483.520	64	3655～ 7555	0
短波 3	7200～15000	1	14510～30110	2	232.160～481.760	32	7255～15055	0
短波 4	14400～30000	1	14455～30055	1	231.280～480.880	16	14455～30055	0
F M	76～108 [MHz]	50	7620～10820	1	304.8～432.8	4	76.2～108.2 [MHz]	0

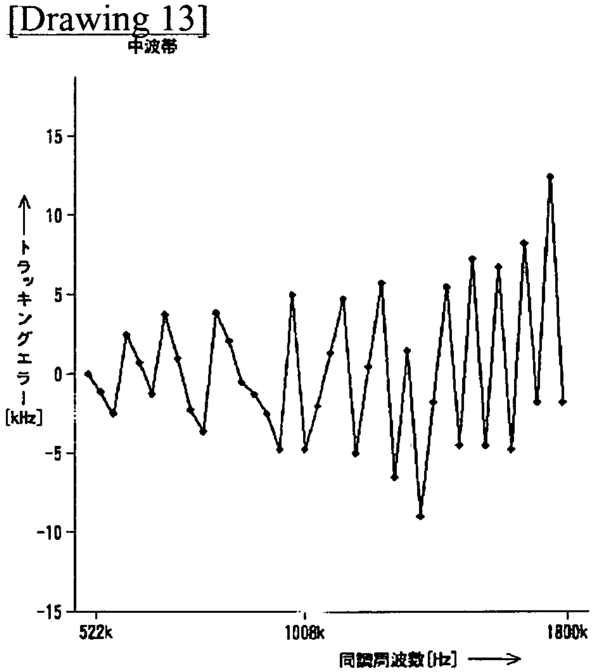
[Drawing 12]



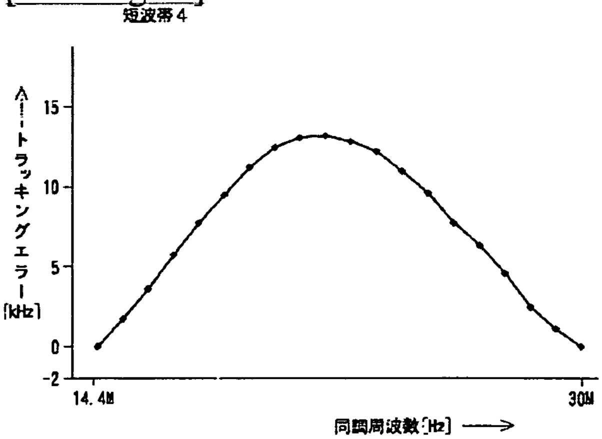
[Drawing 14]



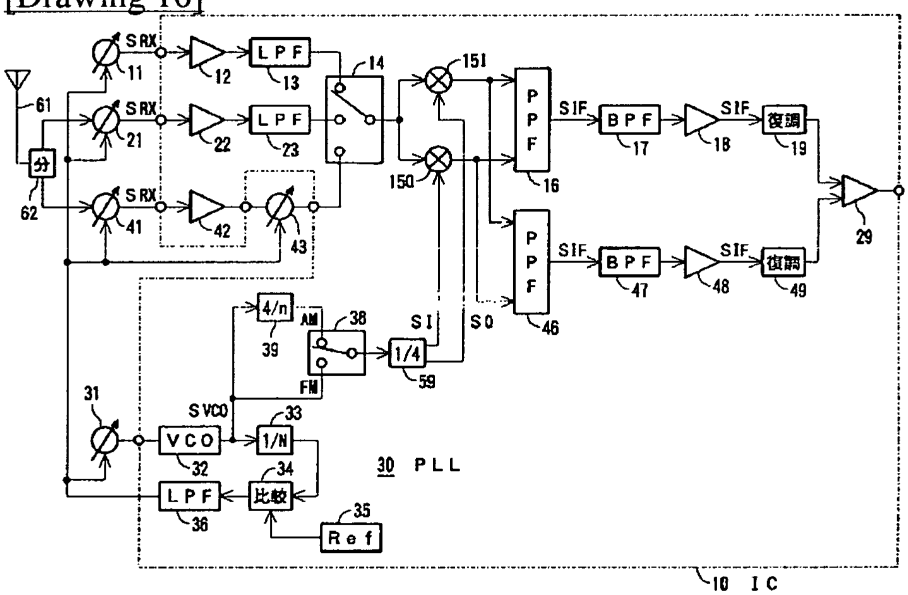
[Drawing 13]



[Drawing 15]



[Drawing 16]



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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to a receiver and IC.
[0002]
[Description of the Prior Art] The superheterodyne receiver of a double conversion mold can be constituted as fundamentally shown in drawing 17 . And if the 1st local oscillation frequency is changed among 58.6MHz - 88.45MHz when the 1st intermediate frequency is set to 58MHz and the 2nd intermediate frequency is set to 450kHz for example, 150kHz - 30MHz can be made into a receiving band.
[0003]
[Problem(s) to be Solved by the Invention] By the way, it sets to the receiver of a superheterodyne system and is fRX:received frequency (frequency which wishes to receive).
fLO:local oscillation frequency fIF: -- an intermediate frequency -- then -- fRX=fLO-fIF ... (1) -- or -- fRX=fLO+fIF ... There is relation of (2) and received frequency fRX is determined by the local oscillation frequency fLO.
[0004] Therefore, if the tuning frequency fTN of an antenna tuning circuit must separate only the intermediate frequency frequency fIF from the local oscillation frequency fLO correctly and an error is in tuning frequency fTN, since, as for the input signal of a frequency fRX, the level will fall, receiving sensibility will fall. In addition, the error of this local oscillation frequency fLO and tuning frequency fTN is called the "tracking error."
[0005] and the case of the receiver of drawing 17 -- actual -- a long wave -- since a ferrite bar antenna will be used for a band (150kHz - 520kHz) and a medium wave band (522kHz - 1800kHz) and a short wave band (1.8MHz - 30MHz) will use an external antenna -- a long wave -- the antenna tuning circuit for a band and medium wave bands and the antenna tuning circuit for short wave bands will be prepared separately.
[0006] However, even if it establishes an antenna tuning circuit in short wave bands, short wave bands are 1.8MHz - 30MHz and a broadband as mentioned above, and, moreover, a tracking error must also take them into consideration. For this reason, in the actual receiver, the antenna tuning circuit for short wave bands divides a short wave band into two or more frequency bands, and let it be the band pass filter which makes each frequency band a passband. That is, let the antenna tuning circuit for short wave bands be a non-aligning mold.
[0007] However, if an antenna tuning circuit is used as a non-aligning mold, since signals other than the frequency made into the purpose will also be supplied after the next step, an interference property will get worse. Furthermore, junction type FET special low noise type needs to constitute the RF amplifier of the next step, and it is necessary to noise[low]-ize it, and at this time, for this reason, RF amplifier will not be able to be IC-ized to other circuits and one, but it will become an assembly and the hindrance of simplification of mounting.
[0008] Moreover, when it makes a receiver a synthesizer method with 60.25MHz - 88.45MHz since the

1st local oscillation frequency was high, and it constitutes the 1st local oscillation circuit from a short wave band by VCO of PLL, phase noise of the 1st local oscillation signal cannot be made small. When the frequency step of received frequency is especially made small, the loop-formation band of PLL cannot be made large, but an improvement of a property becomes difficult still more.
[0009] furthermore, a long wave -- if the antenna tuning circuit for a band and medium wave bands adjusts a padding capacitor (capacitor for amendment of a frequency) so that the tracking error in a medium wave band may become the minimum -- a long wave -- the tracking error in a band -- large -- becoming -- reverse -- a long wave -- if a padding capacitor is adjusted so that the tracking error in a band may become the minimum, the tracking error in a medium wave band will become large.
[0010] Therefore, as for long wave band or a medium wave band, receiving sensibility will fall for a tracking error. And if the antenna tuning circuit for long wave band and medium wave bands is used as a non-aligning mold in order to avoid the fall of this receiving sensibility, the above problems will arise.
[0011] furthermore -- as a receiver -- a long wave -- while having an antenna tuning circuit for the object for bands, and medium wave bands, the data for antenna alignment are prepared for nonvolatile memory, and there are some which carry out D/A conversion of the data corresponding to received frequency among the data, and were supplied to the antenna tuning circuit. That is, if it is made such, the tuning frequency fTN of an antenna tuning circuit can be correctly controlled to the received frequency fRX decided from the local oscillation frequency fLO, and a tracking error will not be produced.
[0012] However, since it is necessary to adjust tuning frequency fTN for every set of a receiver, and to make nonvolatile memory memorize the data at that time in this case, great time and effort and time amount will be taken, and it will become cost quantity.
[0013] This invention tends to solve the above troubles.
[0014]
[Means for Solving the Problem] In the receiver of the superheterodyne system which uses the 1st frequency band and 2nd frequency band as a receiving band at least in this invention, for example A variable frequency oscillator circuit and the good variations circumference way which the oscillation signal of this variable frequency oscillator circuit is supplied, and carries out dividing of this oscillation signal, While having a mixer circuit for carrying out frequency conversion of the input signal to an intermediate frequency signal with a local oscillation signal and supplying the dividing output of the above-mentioned good variations circumference way to the above-mentioned mixer circuit as the above-mentioned local oscillation signal In the time of reception of the 1st frequency band of the above, and reception of the 2nd frequency band of the above it considers as the receiver which changed the received frequency of the 1st frequency band of the above, and the 2nd frequency band of the above which boils, respectively and can be set by changing the division ratio n of the above-mentioned good variations circumference way, and changing the oscillation frequency of the above-mentioned variable frequency oscillator circuit. Therefore, even if a padding capacitor does not adjust a tracking error, by choosing division ratios N and n, antenna tuning voltage is changed and a tracking error is adjusted.
[0015]
[Embodiment of the Invention] ** The 1st configuration and its drawing 1 of operation of a receiver 1. receiver show an example at the time of applying this invention to the multi-band receiver which receives long wave band, a medium wave band, a short wave band, and FM broadcast band. Moreover, in this example, it is the case where a short wave band is divided into four more frequency bands. Furthermore, in this example, the range and frequency step of received frequency in long wave band, a medium wave band, a short wave band, and FM broadcast band are the case where it carries out as shown in drawing 3 .
[0016] in addition -- although the relation between received frequency, a local oscillation frequency, etc. is mentioned later collectively -- a long wave -- the intermediate frequency [intermediate frequency / at the time of reception of a band a medium wave band, and a short wave band] at the time of reception of 55kHz and FM broadcast band is 200kHz.
[0017] And in drawing 1 , the part 10 enclosed with the chain line is the monolithic IC of one chip. While a microcomputer 101 is connected to this IC10 as a system control circuit, various kinds of

actuation keys (actuation switch) 102 are connected to this microcomputer 101 as a user interface. And according to actuation of this actuation key 102, IC10 is controlled by the microcomputer 101.
[0018] That is, the input signal SRX of the frequency fRX which the antenna tuning circuit 11 for long wave band and medium wave bands is constituted by the electronic tuning method with a bar antenna coil (ferrite bar antenna) and variable capacitance diode, and makes the purpose is taken out, this input signal SRX is supplied to the adjustable low pass filter 13 through the RF amplifier 12, and the unnecessary signal component distributed over a high region side rather than an input signal SRX is removed.
[0019] and the input signal SRX outputted from this adjustable low pass filter 13 -- a long wave -- at the time of reception of a band and a medium wave band, one pair of mixer circuits 15I and 15Q are supplied through the switching circuit 14 connected to the condition of drawing by the microcomputer 101.
[0020] Moreover, the oscillation signal SVCO of the predetermined frequency fVCO is taken out from VCO of PLL30 (a detail is mentioned later), this oscillation signal SVCO is supplied to the good variations circumference way 39, and it is the frequency fLO of 1/n (integer which n mentions later). Dividing is carried out to one pair of signals SI and SQ with which 90 degrees of phases differ mutually, and these signals SI and SQ are supplied to mixer circuits 15I and 15Q as a local oscillation signal (frequency fLO).
[0021] In addition, a sign 31 is the resonance circuit of VCO of PLL30, and this is constituted by a coil and variable capacitance diode. And the control voltage VPLL supplied to a resonance circuit 31 from PLL30 is supplied to the antenna tuning circuit 11 as a channel selection electrical potential difference.
[0022] In this way, in mixer circuits 15I and 15Q, frequency conversion of the input signal SRX is carried out to the intermediate frequency signals SIFI and SIFQ of two intermediate frequency signals SIFI and SIFQ, i.e., the I-axis which intersects perpendicularly mutually, from which 90 degrees of phases differ mutually with the local oscillation signals SI and SQ, and a Q-axis. In addition, the intermediate frequency fIF of intermediate frequency signals SIFI and SIFQ is set to 55kHz as mentioned above at this time.
[0023] And these intermediate frequency signals SIFI and SIFQ are supplied to the poliphase filter 16. While a phase shift is carried out so that the original signal component contained in intermediate frequency signals SIFI and SIFQ may become in phase in this poliphase filter 16 and an image component may serve as opposition although omitted for details since this poliphase filter 16 is explained in full detail, for example in JP,2001-77648,A, the signal of that phase shift result is added mutually. Therefore, an image component is offset and the intermediate frequency signal SIF which has an original signal component is taken out from the poliphase filter 16.
[0024] And the intermediate frequency signal SIF outputted from this poliphase filter 16 is supplied to the band pass filter 17 for intermediate frequency filters, and after an unnecessary signal component is removed, a demodulator circuit 19 is supplied through amplifier 18. This demodulator circuit 19 is constituted so that the recovery corresponding to AM, DSB and SSB, Narrow-band FM, etc. can be performed, and in this demodulator circuit 19, an audio signal recovers it from an intermediate frequency signal SIF. And this audio signal is taken out from IC10 through the buffer amplifier 29. Therefore, reception of long wave band and a medium wave band can be performed.
[0025] Moreover, at the time of reception of a short wave band, the broadcast wave (signals, such as a ham radio, are also included) of a short wave band is received by the antenna 61, and the input signal SRX of the frequency fRX which this input signal is supplied to the antenna tuning circuit 21 of an electronic tuning method through a distributor 62, and makes the purpose is taken out.
[0026] And this input signal SRX is supplied to the adjustable low pass filter 23 through the RF amplifier 22, and the unnecessary signal component distributed over a high region side rather than an input signal SRX is removed. And the input signal SRX outputted from this adjustable low pass filter 23 is supplied to mixer circuits 15I and 15Q through the switching circuit 14 connected to the condition contrary to drawing by the microcomputer 101 at the time of reception of a short wave band.
[0027] Moreover, dividing is carried out to one pair of signals SI and SQ with which the oscillation

signal SVCO of the predetermined frequency fVCO is supplied to the good variations circumference way 39 from VCO of PLL30, and 90 degrees of phases differ mutually on a frequency fLO, and these signals SI and SQ are supplied to mixer circuits 15I and 15Q as a local oscillation signal (frequency fLO).

[0028] And henceforth, the same processing as the time of reception of long wave band and a medium wave band is performed, an audio signal is outputted from a demodulator circuit 19, and this audio signal is taken out from IC10. Therefore, reception of a short wave band can be performed.

[0029] Furthermore, at the time of reception of FM broadcast band, the broadcast wave of FM broadcast band is received by the antenna 61, and the input signal SRX of the frequency fRX which this input signal is supplied to the antenna tuning circuit 41 of an electronic tuning method through a distributor 62, and makes the purpose is taken out. And this input signal SRX is further supplied to one pair of mixer circuits 45I and 45Q through the RF amplifier 42 through the interstage tuning circuit 43 which has variable capacitance diode.

[0030] Moreover, the oscillation signal SVCO of the predetermined frequency fVCO is taken out from VCO of PLL50, dividing is carried out to one pair of signals SI and SQ with which this oscillation signal SVCO is supplied to a frequency divider 59, and 90 degrees of phases differ mutually on one fourth of the frequencies fLO, and these signals SI and SQ are supplied to mixer circuits 45I and 45Q as a local oscillation signal (frequency fLO).

[0031] In addition, a sign 51 is the resonance circuit of VCO of PLL50, and this is constituted by a coil and variable capacitance diode. And the control voltage VPLL supplied to a resonance circuit 51 from PLL50 is supplied to the antenna tuning circuit 41 as a channel selection electrical potential difference.

[0032] In this way, in mixer circuits 45I and 45Q, frequency conversion of the input signal SRX is carried out to the intermediate frequency signals SIFI and SIFQ of two intermediate frequency signals SIFI and SIFQ, i.e., the I-axis which intersects perpendicularly mutually, from which 90 degrees of phases differ mutually with the local oscillation signals SI and SQ, and a Q-axis. In addition, the intermediate frequency fIF of intermediate frequency signals SIFI and SIFQ is set to 200kHz as mentioned above at this time.

[0033] And while a phase shift is carried out so that the original signal component which these intermediate frequency signals SIFI and SIFQ are supplied to the poliphase filter 46, for example, is contained in intermediate frequency signals SIFI and SIFQ may become in phase and an image component may serve as opposition, the signal of the phase shift result is added mutually. Therefore, an image component is offset and the intermediate frequency signal SIF which has an original signal component is taken out from the poliphase filter 46.

[0034] And the intermediate frequency signal SIF outputted from this poliphase filter 46 is supplied to the band pass filter 47 for intermediate frequency filters, after an unnecessary signal component is removed, the FM demodulator circuit 49 is supplied through amplifier 48, an audio signal gets over, and this audio signal is taken out from IC10 through the buffer amplifier 29. Therefore, reception of FM broadcast band can be performed.

[0035] 2. An antenna tuning circuit and example drawing 2 of PLL indicate examples with PLL30 to be the antenna tuning circuit 11 for long wave band and medium wave bands, and the antenna tuning circuit 21 for short wave bands. That is, in the antenna tuning circuit 11, while parallel connection of the bar antenna coil L11, a capacitor C11, and the variable capacitance diode D11 is carried out in high frequency, parallel connection of the diode D12 for switching is carried out in high frequency to some coils L11. And the band switch electrical potential difference VLM is supplied to diode D12 from a microcomputer 101.

[0036] Moreover, in the antenna tuning circuit 21, while parallel connection of the coils L22-L24 is carried out to a coil L21 in high frequency through the diodes D22-D24 for switching, parallel connection of a capacitor C21 and the variable capacitance diode D21 is carried out to a coil L21 in high frequency. And the band switch electrical potential differences VS2-VS4 are supplied to diodes D22-D24 from a microcomputer 101. Moreover, the signal of the broadcast wave which the antenna 61 received through the distributor 62 about the tap of a coil L21 is supplied.

[0037] Furthermore, in a resonance circuit 31, parallel connection of a capacitor C31 and the series circuit of variable capacitance diodes D31 and D32 is carried out to a coil L31 in RF through a padding capacitor C32. And this resonance circuit 31 is connected to VCO32. In addition, let variable capacitance diodes D11, D21, D31, and D32 of each other be the things of the same property.

[0038] And PLL30 is constituted as follows. That is, while the oscillation signal SVCO of VCO32 is supplied to the good variations circumference way 33, dividing is carried out to the frequency of 1-/N and at least that dividing signal is supplied to the phase comparator circuit 34, the stable frequency which serves as criteria from the reference signal formation circuit 35, for example, a 4kHz alternation signal, is taken out, and this alternation signal is supplied to a comparator circuit 34. And the direct current voltage VPLL from which level changes corresponding to the phase contrast of two signals with which the comparison output of this comparator circuit 34 was supplied to the low pass filter 36, and was supplied to the comparator circuit 34 is taken out, and this electrical potential difference VPLL is supplied to the variable capacitance diodes D31 and D32 of a resonance circuit 31 as that control voltage.

[0039] Furthermore, an electrical potential difference VPLL is supplied to the variable capacitance diodes D11 and D21 of tuning circuits 11 and 21 as the control voltage. Moreover, dividing is carried out to the signals SI and SQ with which the oscillation signal SVCO of VCO32 is supplied to the good variations circumference way 39, and 90 degrees of phases differ mutually on the frequency of 1/n as mentioned above, and these signals SI and SQ are supplied to mixer circuits 15I and 15Q.

[0040] Furthermore, it is formed like [PLL50] PLL30. However, reference frequency of the alternation signal outputted from the formation circuit corresponding to the formation circuit 35 among PLL50 is set to 50kHz.

[0041] And at the time of reception of long wave band, it is presupposed by the band switch electrical potential difference VLM from a microcomputer 101 that diode D12 is off, and the inductance of a coil L11 is enlarged, consequently it is made for a tuning circuit 11 to correspond to long wave band. Then, since the capacity of variable capacitance diode D11 changes corresponding to the electrical potential difference VPLL from PLL30 at this time, the tuning frequency fTN of a tuning circuit 11 changes corresponding to the local oscillation frequency fLO. Therefore, reception of long wave band can be performed.

[0042] Moreover, at the time of reception of a medium wave band, diode D12 is set to ON by the band switch electrical potential difference VLM, and the inductance of a coil L11 is made small, consequently it is made for a tuning circuit 11 to correspond to a medium wave band. Then, since the capacity of variable capacitance diode D11 changes corresponding to the electrical potential difference VPLL from PLL30 at this time, the tuning frequency fTN of a tuning circuit 11 changes corresponding to the local oscillation frequency fLO. Therefore, reception of a medium wave band can be performed. In addition, a padding capacitor C32 is adjusted so that a tracking error may serve as the minimum in a medium wave band in this case.

[0043] Furthermore, at the time of reception of the short wave band 1, diodes D22-D24 are set to OFF by the band switch electrical potential differences VS2-VS4, and only a coil L21 is used for antenna alignment. Then, the capacity of variable capacitance diode D21 changes corresponding to the electrical potential difference VPLL from PLL30 at this time. Therefore, the tuning frequency fTN of a tuning circuit 21 will change corresponding to the local oscillation frequency fLO, and can perform reception of the frequency band of the short wave band 1.

[0044] Moreover, while diode D22 is set to ON by the band switch electrical potential differences VS2-VS4 at the time of reception of the short wave band 2, it is supposed that diodes D23 and D24 are off, parallel connection of the coil L22 is carried out to a coil L21, and it is used for antenna alignment. Then, the capacity of variable capacitance diode D21 changes corresponding to the electrical potential difference VPLL from PLL30 at this time. Therefore, the tuning frequency fTN of a tuning circuit 21 will change corresponding to the local oscillation frequency fLO, and can perform reception of the frequency band of the short wave band 2.

[0045] Furthermore, while diode D23 or D24 is set to ON by the band switch electrical potential

differences VS2-VS4 at the time of reception of the short wave band 3 or the short wave band 4, other diodes are set to OFF, parallel connection of a coil L23 or L24 is carried out to a coil L21, and it is used for antenna alignment. Then, the capacity of variable capacitance diode D21 changes corresponding to the electrical potential difference VPLL from PLL30 at this time. Therefore, the tuning frequency fTN of a tuning circuit 21 will change corresponding to the local oscillation frequency fLO, and can perform reception of the frequency band of the short wave band 3 or the short wave band 4.
[0046] 3. Although it is as the range and frequency step of received frequency fRX in each frequency band showing the frequency of each signal to drawing 3 in the receiver of drawing 1 , in order to realize this frequency, it is controlled so that the division ratio N of the good variations circumference way 33 of PLL30 and the division ratio n of the good variations circumference way 39 show drawing 3 with a microcomputer 101.
[0047] That is, since the frequency of the output signal of the good variations circumference way 33 is equal to the frequency of 4kHz of the reference signal outputted from the formation circuit 35 in drawing 2 at the time of a stationary, it is the oscillation frequency fVCO of VCO32 at this time.
fVCO=4xN [kHz] ... It is set to (3). Moreover, frequency fLO of the output signals SI and SQ of the good variations circumference way 39 at this time (local oscillation frequency) fLO=fVCO/n = 4xN/n [kHz] ... It is set to (4).
[0048] And in long wave band, although the frequency of 150kHz and 520kHz, and the frequency of the 9kHz step of the range of 153kHz - 513kHz turn into received frequency fRX, as division ratios N and n show drawing 3 , it is set up for this reason.
[0049] That is, when setting received frequency fRX to 150kHz, it is set as N= 9225 and n= 180. Then, as shown also in drawing 3 , the oscillation frequency fVCO at this time is fVCO=4x9225=36900[kHz] from (3) types.
A next door and the local oscillation frequency fLO are fLO=4x9225 / 180= 205 [kHz] from (4) types.
It becomes. Therefore, the received frequency fRX decided from the local oscillation frequency fLO is fRX=fLO-fIF=205-55=150[kHz] from (1) type at this time.
It becomes the received frequency of 150kHz made into a next door and the purpose.
[0050] Similarly, when setting received frequency fRX to 153kHz, it is set as N= 9360 and n= 180.
Then, it is fVCO=4x9360=37440[kHz] at this time.
fLO =4x9360 / 180= 208 [kHz]
fRX =208-55=153[kHz]
It becomes and becomes the target received frequency of 153kHz.
[0051] Furthermore, when setting received frequency fRX to 162kHz, it is set as N= 9873 and n= 182.
Then, it is fVCO=4x9873=39492[kHz] at this time.
fLO =4x9873 / 182**216.989 [kHz]
It becomes.
[0052] And for the received frequency fRX made into the purpose at this time, since it is 162kHz, (1) type to the local oscillation frequency fLO is fLO=162+55=217[kHz].
It must come out and is 216.989-217=-0.011[kHz] to the local oscillation frequency fLO.
= -11 [Hz]
****** will be produced.
[0053] However, if it is an error of this level, since it is fully small compared with the intermediate frequency of 55kHz, trouble cannot be caused to reception and it can ignore. Therefore, it is satisfactory at the above-mentioned division ratio N= 9873 and n= 182.
[0054] And the same is said of other received frequency fRX, and it can receive at a 9kHz step in a long wave with a - of 150kHz [of bands] by carrying out the increment in monotone of the division ratios N and n to the rise of received frequency fRX.
[0055] Moreover, in a medium wave band, although the frequency of a 9kHz step turns into received frequency fRX in 522kHz - 1800kHz, as division ratios N and n show drawing 3 , it is set up for this reason.
[0056] That is, while changing a division ratio N at 144 steps in 9232-29680 at the time of reception of a

medium wave band, it fixes to n= 64. Then, the local oscillation frequency fLO at the time of N= 9232 is fLO=4x9232 from (4) types / 64= 577 [kHz].
fRX=fLO-fIF=577from next door and (1) type-55=522[kHz]
It becomes a next door and the received frequency of 522kHz.
[0057] Moreover, the local oscillation frequency fLO at the time of N= 29680 is fLO=4x29680 from (4) types / 64= 1855 [kHz].
fRX=1855from next door and (1) type-55=1800[kHz]
It becomes a next door and the received frequency of 1800kHz.
[0058] And when variation deltafLO of the local oscillation frequency fLO to variation deltaN of a division ratio N is calculated, it is from (4) types. deltafLO=4xdeltaN/n ... Since it is set to (5), if it changes 144 steps of division ratios N at a time, it will be deltafLO=4x144 from (5) types / 64= 9 [kHz].

A next door and the local oscillation frequency fLO change at a 9kHz step.
[0059] Therefore, 522kHz - 1800kHz of medium wave bands is receivable at a 9kHz step by setting it as n= 64 and changing the range of N=9232-29680 at 144 steps.
[0060] In addition, it sets on this medium wave band, and the variability region of the oscillation frequency fVCO of VCO32 is fVCO=4x9232[kHz]-4x29680[kHz] from (3) types.
= 36.928 [MHz] - 118.72[MHz]
It becomes.
[0061] Furthermore, since it changes as the oscillation frequency fVCO and the local oscillation frequency fLO of VCO32 show division ratios N and n to drawing 3 by setting up as shown at drawing 3 at the time of reception of the frequency band of the short wave band 1 - the short wave band 4, 1.8MHz - 30MHz of short wave bands is receivable at a 1kHz step. In addition, it is as the variability region of the oscillation frequency fVCO of VCO32 at this time also being shown in drawing 3 .
[0062] Moreover, at the time of reception of FM broadcast band, since reference frequency in PLL50 is set to 50kHz, as shown in drawing 3 , the range whose oscillation frequency fVCO of VCO of PLL50 is 304.8MHz - 432.8MHz is changed at a 50kHz step by changing the division ratio N of the good variations circumference way of PLL50 every [1] in 1524-2164.
[0063] Therefore, since the local oscillation frequency fLO of the dividing signals (local oscillation signal) SI and SQ outputted from a frequency divider 59 will change the range of 76.2MHz - 108.2MHz at a 50kHz step corresponding to a division ratio N, it can receive 76MHz - 108MHz FM broadcast band at a 50kHz step.
[0064] 4. Since the local oscillation frequency fLO is decided by combination of two division ratios N and n as shown also in (4) types when receiving conclusion broadcast, even if the local oscillation frequency fLO is the same, the oscillation frequency fVCO of VCO32 can be changed by changing division ratios N and n. And when this oscillation frequency fVCO is changed, while the magnitude of the control voltage VPLL supplied to VCO32 will change, this control voltage VPLL is supplied to the antenna tuning circuit 11 as that tuning voltage.
[0065] Therefore, since the tuning voltage VPLL of the antenna tuning circuit 11 can be changed by changing division ratios N and n even if the local oscillation frequency fLO is the same, the tuning frequency fTN of the antenna tuning circuit 11 can be changed at this time. Therefore, even if it adjusts a padding capacitor C32 as mentioned above so that the tracking error in a medium wave band may become the minimum, the tracking error in long wave band can be made into the minimum by changing division ratios N and n by long wave band.
[0066] Drawing 4 - drawing 6 show the result of having carried out simulation of the magnitude of the tracking error in long wave band and a medium wave band by count. That is, drawing 4 and drawing 5 show the relation between the tuning frequency fTN at the time of fixing a division ratio n to n= 144, and the magnitude of a tracking error for a comparison.
[0067] And drawing 4 is a property when adjusting a padding capacitor C32 so that a tracking error may serve as the minimum in long wave band, and drawing 5 is a property when adjusting a padding capacitor C32 so that a tracking error may serve as the minimum in a medium wave band. And at the

time of the property of drawing 4 , it was 32= 850pF of C, and was 32= 3000pF of C at the time of the property of drawing 5 . That is, long wave band differs in the capacity of the padding capacitor C32 which makes a tracking error the minimum from the medium wave band as mentioned above.
[0068] And drawing 6 shows the property of the tracking error in the long wave band at the time of applying this invention. In this case, as shown also in drawing 5 , the capacity (32= 3000pF of C) of a padding capacitor C32 is adjusted so that the tracking error of a medium wave band may serve as the minimum.
[0069] And according to the property of drawing 6 , the magnitude of a tracking error changes with tuning frequency fTN rapidly, but the magnitude itself improves compared with the property of drawing 4 . that is, a medium wave band -- adjustment of a tracking error -- carrying out -- a long wave -- even if a band does not adjust a tracking error -- a long wave -- when a band adjusts, the above good tracking property has been acquired.
[0070] In this way, even if it adjusts a padding capacitor C32 so that the tracking error in a medium wave band may become the minimum, the tracking error in long wave band can be made into the minimum by changing a division ratio n by long wave band. Therefore, it can consider as a highly sensitive receiver.
[0071] In addition, since a division ratio n can be enlarged, consequently change of the local oscillation frequency fLO to change of a division ratio n can be made small so that also from (4) types, and the oscillation frequency fVCO of VCO32 becomes high, a tracking error can be made smaller.
[0072] Moreover, since the antenna tuning circuit 11 with few tracking errors can be used, signals other than the received frequency made into the purpose can be prevented certainly, consequently an interference property becomes good. Furthermore, since the antenna tuning circuits 11 and 21 can be formed, it becomes easy, and matching is strong to an interference and can consider as a high sensitivity receiver. Moreover, since the antenna tuning circuits 11 and 21 can be formed, even if a current amplification factor constitutes the high frequency amplifier 12 and 22 of the next step by the junction type transistor which is about 100, it can make NF small enough, therefore can on-chip-ize the high frequency amplifier 11 and 21 in IC10 at other circuits and one.
[0073] Furthermore, although PLL30 is used common to long wave band, a medium wave band, and a short wave band it is shown also in drawing 3 -- as -- a long wave -- the variability region of the oscillation frequency fVC0 of VCO32 at the time of reception of a band and a short wave band Since it is contained mostly in the variability region of the oscillation frequency fVCO which can be set at the time of reception of a medium wave band and it is not necessary to oscillate on a special frequency, neither a resonance circuit 31 nor a property special as VCO32 nor the thing of a configuration is needed.
[0074] Moreover, since dividing of the oscillation signal SVCO formed of VCO32 was carried out to 1 / 207 - 1/4 (n=207-4) on the good variations circumference way 39 and the local oscillation signals SI and SQ have been acquired, phase noise of the local oscillation signals SI and SQ can be made small corresponding to a division ratio n. Therefore, it is digital broadcasting, and when receiving the broadcast wave signal accompanied by a phase modulation, it can consider as a more suitable receiver.
[0075] Furthermore, since it is not necessary to prepare the nonvolatile memory which memorizes the data for alignment of the antenna tuning circuits 11 and 21, or to make nonvolatile memory memorize in quest of the data the whole set of a receiver, manufacture can take neither time and effort nor time amount, but the rise of cost can be suppressed.
[0076] Moreover, although the band (150kHz - 30MHz) from long wave band to a short wave band is receivable, since it is good at one PLL30, it is advantageous to IC-izing. And the antenna tuning circuits 11 and 21 and all the circuits except the resonance circuit 31 of PLL30 can be mounted in IC10, and a multi-band receiver with few external components can be offered cheaply.
[0077] Furthermore, since the oscillation frequency fVCO of VCO32 turns into a frequency far higher than a receiving band, even if the oscillation signal SVCO of VCO32 is received by the antenna 61, it can prevent with the easy low pass filters 13 and 23, and is hard to generate reception active jamming. Moreover, in mixer circuits 15I and 15Q, even if it produces spurious active jamming by the higher

harmonic of the local oscillation signals SI and SQ, the signal component which does the spurious active jamming with low pass filters 13 and 23 can be prevented. And a property can be improved, without increasing components mark and the time and effort of adjustment by building low pass filters 13 and 23 in IC10 then.

[0078] Moreover, although two PLL 30 and 50 is needed in order to receive long wave band, a medium wave band, a short wave band, and FM broadcast band it is shown also in drawing 3 -- as -- a long wave -- the oscillation frequency fVCO of VCO32 of PLL30 for a band, a medium wave band, and short wave bands Compared with the oscillation frequency of VCO of PLL50 for FM broadcast bands, it is low, and at the time of reception of long wave band, a medium wave band, and a short wave band, since the power source of PLL50 can be turned OFF, even if it forms two PLL 30 and 50, it is advantageous in respect of power consumption.

[0079] Furthermore, since the frequency of an intermediate frequency signal SIF is low, when carrying out digital processing of the next signal from this intermediate frequency signal SIF, this becomes possible easily. Furthermore, since the intermediate frequency fIF is low, while being able to carry out [on chip]-izing of the band pass filter 17 which chooses the intermediate frequency signal SIF to IC10, a required crystal filter becomes unnecessary with the receiver of the double conversion mold shown in drawing 17 , and cost can be lowered.

[0080] 5. Example drawing 7 of an adjustable low pass filter shows the example of the adjustable low pass filters 13 and 23. In this example, the adjustable low pass filters 13 and 23 are the cases where a cut off frequency can be changed, by being constituted by the BAIKADDO mold and changing the value of that resistor.

[0081] That is, an input terminal T71 is connected to the reversal input edge of an operational amplifier A71 through the variable-resistance circuit R71 mentioned later, and the parallel circuit of a capacitor C71 and the variable-resistance circuit R72 is connected between the outgoing end and a reversal input edge.

[0082] Moreover, while the outgoing end of an operational amplifier A71 is connected to the reversal input edge of the operational amplifier amplifier A72 through the variable-resistance circuit R73 and the outgoing end of this operational amplifier A72 is connected to an output terminal T72, a capacitor C72 is connected between that outgoing end and a reversal input edge.

[0083] Furthermore, the outgoing end of an operational amplifier A72 is connected to the reversal input edge of an operational amplifier A73 through a resistor R75, a resistor R76 is connected between the outgoing end of this operational amplifier A73, and a reversal input edge, and that outgoing end is connected to the reversal input edge of an operational amplifier A71 through the variable-resistance circuit R74 between.

[0084] And the resistance of the variable-resistance circuits R71-R74 is controlled by the microcomputer 101 to mention later. Moreover, although illustration is not carried out, the noninverting input edge of operational amplifiers A71-A73 is grounded. Furthermore, C71=C72 R73=R74 It is referred to as R75=R76.

[0085] While this circuit operates as secondary low pass filter according to such a configuration, that cut off frequency f13, Gain AV, and Q value are f13=1/(2piC71, R73) [Hz].

AV =R73 / R71[twice]

Q =R It is set to 72 / R73.

[0086] Therefore, if the value of the variable-resistance circuits R73 and R74 is changed, a cut off frequency f13 can be changed, and if the value of the variable-resistance circuits R71 and R72 is changed into coincidence at this time, even if it changes a cut off frequency f13, Gain AV and Q value will not change.

[0087] And each of the variable-resistance circuits R71-R74 can be constituted as shown in drawing 8 . That is, while a resistor R85 is connected between a terminal T81 and a terminal T82, each series circuit of a between [resistor R84-R80 and the drain source of FET (Q84-Q80)] is connected. Moreover, the bits b4-b0 of predetermined control data are supplied to the gate of FET (Q84-Q80) from a microcomputer 101, respectively.

[0088] And when these variable-resistance circuits R71-R74 are used for the filters 13 and 23 of drawing 7 , the variable-resistance circuits R71 and R73 are connected so that a terminal T81 may be a preceding paragraph side and a terminal T82 may be on a latter-part side, and the variable-resistance circuits R72 and R74 are connected so that a terminal T81 may be a latter-part side and a terminal T82 may be on a preceding paragraph side. That is, it connects so that the variable-resistance circuits R71-R74 may be seen from the signal which flows, respectively, a terminal T81 may serve as an input side and a terminal T82 may serve as an output side.
[0089] Moreover, if predetermined resistance is made into a value R, the resistance of resistors R85-R80 corresponds to the weight of bits b4-b0. R85=5/2, andR R84=5/3, andR R83=10/3, andR R82=20/3, andR R81=40/3, andR It is referred to as R80=80/3, andR.
[0090] Furthermore, the gate width W24-W20 of FET (Q84-Q80) is also equivalent to the weight of bits b5-b0, for example, it is W24=24micrometer. W23=16micrometerW22=8micrometer W21=4micrometer It may be W20=2micrometer.
[0091] FET to which it corresponds of FET (Q84-Q80) if the bit of the arbitration of the bits b4-b0 is set to "1" or "0" according to such a configuration -- ON -- or it becomes off and parallel connection of the resistors R84-R80 is carried out to a resistor R85 corresponding to turning on and off of this FET (Q84-Q80).
[0092] therefore, the resistance R70 between a terminal T81 and a terminal T82 turns into a value of 0-31 shown in R70=80/(32+3m) and the Rm:bits b4-b0, and resistance R70 changes between 2.5R-0.64R over 32 steps -- things -- ** Therefore, this circuit can be used as variable-resistance circuits R71-R74.
[0093] ** the configuration of the 2nd receiver 1. receiver, and the actuation above-mentioned receiver -- setting -- a long wave -- although it is the case where formed PLL30 as an object for reception of a band, a medium wave band, and a short wave band, and PLL50 is formed as an object for reception of FM broadcast band, these PLL 30 and 50 can also be shared. Drawing 9 shows an example at the time of making small the variability region of the oscillation frequency of VCO of PLL further while constituting it such.
[0094] That is, in this receiver, PLL50 in the receiver of drawing 1 is removed. And as shown also in drawing 10 , while the oscillation signal SVCO outputted from VCO32 is supplied to the good variations circumference way 39, a frequency divider 59 is supplied. Moreover, the formation circuit 35 is constituted by a ridge oscillator 351 and the good variations circumference way 352 which carries out dividing of the oscillation signal.
[0095] And the division ratio of the good variations circumference way 352 is controlled by the microcomputer 101, from the good variations circumference way 352, a dividing signal with a frequency of 16kHz is taken out at the time of reception of long wave band, a medium wave band, and a short wave band, a dividing signal with a frequency of 55kHz is taken out at the time of reception of FM broadcast band, and at least this dividing signal is supplied to the phase comparator circuit 34 as a reference signal. In addition, the intermediate frequency fIF at the time of reception of long wave band, a medium wave band, and a short wave band sets the intermediate frequency fIF at the time of reception of 55kHz and FM broadcast band to 200kHz.
[0096] 2. About the frequency of each signal, in this receiver, the division ratios N and n of the good variations circumference ways 33 and 39 are controlled so that a microcomputer 101 shows to drawing 11 corresponding to a receiving band and received frequency fRX.
[0097] Then, at the time of reception of long wave band, a medium wave band, and a short wave band, it is made to be the same as that of (3) types and (4) types. fVCO=16xN [kHz] ... (6) fLO =16xN/n [kHz] ... It is fVCO=227968[kHz] as it is shown also in N= 14248, n= 1112, then drawing 11 , for example, since it is set to (7).
fLO =205.007[kHz]
Received frequency fRX is set to 150kHz from a next door and (1) type.
[0098] In addition, in long wave band and a medium wave band, long wave band and a medium wave band are receivable at a 9kHz step by carrying out monotone reduction of the division ratios N and n to the rise of received frequency fRX.

[0099] Moreover, at the time of reception of FM broadcast band, it is made the same. fVCO=40xN [kHz] ... (8) fLO =40xN/n [kHz] ... It is fVCO=304800[kHz] as it is shown also in N= 7620, n= 4, then drawing 11 , for example, since it is set to (9).
fLO =76200[kHz]
Received frequency fRX is set to 76MHz from a next door and (1) type.
[0100] That is, since it changes as the oscillation frequency fVCO of VCO32 shows drawing 11 corresponding to division ratios N and n, and it changes as the local oscillation frequency fLO shows in this drawing, in each receiving band, it can consider as the target received frequency fRX.
[0101] 3. Collectively, as mentioned above, even if the local oscillation frequency fLO is the same, by changing division ratios N and n, the tuning voltage VPLL of the antenna tuning circuit 11 can be changed, and the tuning frequency fTN of the antenna tuning circuit 11 can be changed. Therefore, even if it adjusts a padding capacitor C32 so that the tracking error in a short wave band may become the minimum, the tracking error in long wave band and a medium wave band can be made into the minimum by changing division ratios N and n with long wave band and a medium wave band.
[0102] Drawing 12 - drawing 15 show the result of having carried out simulation of the magnitude of the tracking error in long wave band, a medium wave band, and a short wave band by count. That is, drawing 14 and drawing 15 are the properties when adjusting a padding capacitor C32 so that a tracking error may serve as the minimum in the short wave band 1 (1.8MHz - 3.75MHz) and the short wave band 4 (14.4MHz - 30MHz).
[0103] And drawing 12 and drawing 13 show the property of the tracking error in the long wave band and the medium wave band at the time of carrying out tracking adjustment with the short wave band 1 and the short wave band 4. according to this property -- a short wave band -- adjustment of a tracking error -- carrying out -- a long wave -- even if a band and a medium wave band do not adjust a tracking error -- a long wave -- tracking property sufficient with a band and a medium wave band has been acquired.
[0104] In this way, even if it adjusts a padding capacitor C32 so that the tracking error in a short wave band may become the minimum, the tracking error in long wave band and a medium wave band can be made into the minimum by changing division ratios N and n with long wave band and a medium wave band. Therefore, it can consider as a highly sensitive receiver in all bands.
[0105] although [moreover,] the height ratio (ratio of the highest frequency and lowest frequency) of the oscillation frequency fVCO of VCO32 of a short wave band which boils, respectively and can be set is about two -- receiving -- a long wave, although the height ratio of the received frequency in a band and a medium wave band is three or more Since the height ratio of the oscillation frequency fLO of VCO32 in long wave band and a medium wave band has also become about two by changing division ratios N and n (i.e., since the height ratio of the oscillation frequency fLO is about two in every receiving band), it can consider as a good tracking property.
[0106] Furthermore, although all receiving bands are covered by one VCO32, in every receiving band, the frequency range of the oscillation frequency fVCO is about 230MHz - 500MHz, and is almost equal. therefore, a long wave -- since from a band to FM broadcast-band band is receivable reasonable with one VCO30, components mark can be reduced and the receiver of a multi-band can be realized with a very simple configuration.
[0107] ** the receiver shown in the 3rd configuration and its drawing 9 of operation of a receiver 1. receiver -- setting -- a long wave -- although it is the case where PLL for reception of a band, a medium wave band, and a short wave band and PLL for reception of FM broadcast band are shared, further, mixer circuits 15I and 15Q and mixer circuits 45I and 45Q can also be shared, and drawing 16 shows an example of the receiver constituted such.
[0108] That is, the input signal SRX of the long wave band outputted from a low pass filter 13 and a medium wave band, the input signal SRX of the short wave band outputted from a low pass filter 23, and the input signal SRX of FM broadcast band outputted from the interstage tuning circuit 43 are supplied to the switching circuit 14 for a band switch. And this switching circuit 14 switches with a microcomputer 101, is controlled, the input signal SRX of the receiving band made into the purpose is

chosen and taken out, and the input signal SRX of this selection result is supplied to mixer circuits 15I and 15Q.
[0109] Moreover, while the oscillation signal SVCO of VCO32 (frequency fVCO) is supplied to the FM side contact of the switching circuit 38 for a band switch, the good variations circumference way 39 is supplied, dividing is carried out to the signal of the frequency of 4/n, and this dividing signal is supplied to the AM side contact of a switching circuit 38. And dividing is carried out to one pair of signals SI and SQ with which the output signal of this switching circuit 38 is supplied to a frequency divider 59, and 90 degrees of phases differ mutually on one fourth of frequencies, and these signals SI and SQ are supplied to mixer circuits 15I and 15Q as a local oscillation signal (frequency fLO).
[0110] In addition, a microcomputer 101 connects with the AM side contact at the time of reception of long wave band, a medium wave band, and a short wave band, and a switching circuit 38 is connected to the FM side contact at the time of reception of FM broadcast band. Moreover, the intermediate frequency fIF at the time of reception of long wave band, a medium wave band, and a short wave band sets the intermediate frequency fIF at the time of reception of 55kHz and FM broadcast band to 200kHz.

[0111] 2. About the frequency of each signal, also in this receiver, the division ratios N and n of the good variations circumference ways 33 and 39 are controlled so that a microcomputer 101 shows to drawing 11 corresponding to a receiving band and received frequency fRX.
[0112] and at the time of reception of long wave band, a medium wave band, and a short wave band A switching circuit 38 is connected to the AM side contact as shown in drawing. The oscillation signal SVCO of VCO32 Since dividing is carried out to Signals SI and SQ by two frequency dividers 39 and 59 and mixer circuits 15I and 15Q are supplied, the frequency SLO of the local oscillation signals SI and SQ serves as SLO=(4/n) x(1/4) xfVCO=1/nxfVCO.
[0113] Moreover, at the time of reception of FM broadcast band, since it connects with the FM side contact contrary to drawing, dividing of the oscillation signal SVCO of VCO32 is carried out to Signals SI and SQ by the frequency divider 59 and a switching circuit 38 is supplied to mixer circuits 15I and 15Q, the frequency SLO of the local oscillation signals SI and SQ serves as SLO=1/4xfVCO.
[0114] And also in this receiver, it changes, as the oscillation frequency fVCO of VCO32 shows drawing 11 corresponding to division ratios N and n, and as the local oscillation frequency fLO shows in this drawing, it changes. Therefore, in each receiving band, it can consider as the target received frequency fRX.
[0115] 3. Since it collects, an image component is offset by phase shift processing and data processing in the poliphase filters 16 and 46 as mentioned above and he is trying to obtain an original intermediate frequency component, the intermediate frequency signals SIFI and SIFQ outputted from mixer circuits 15I and 15Q must have equal level correctly, and phase contrast must be 90 degrees. And in this receiver, since mixer circuits 15I and 15Q and a frequency divider 59 required in order to form such intermediate frequency signals SIFI and SIFQ are good at 1 set, reservation of a required property or precision becomes easy.
[0116] ** In addition to this in above-mentioned IC10, an AGC circuit and a stereo demodulator circuit can also be on-chip-ized. Moreover, what is necessary is in the case of the receiver of digital broadcasting, to establish an A/D converter circuit in the next step of the poliphase filters 16 and 46, and just to carry out digital processing of the intermediate frequency signal SIF or subsequent ones.
[0117] [A list of the abbreviations currently used on these specifications]
AM : Amplitude ModulationD/A:Digital to AnalogDSB:Double Side BandFET:Field Effect TransistorFM : Frequency ModulationIC : Integrated CircuitNF : Noise FigurePLL:Phase Locked LoopSSB:Single Side BandVCO:Voltage Controlled Oscillator [0118]
[Effect of the Invention] According to this invention, in a multi-band receiver, even if it adjusts a padding capacitor so that the tracking error in a certain receiving band may become the minimum, in other receiving bands, a tracking error can be made into the minimum by choosing division ratios N and n. Therefore, every receiving band can be used as a highly sensitive receiver.
[0119] Moreover, since an antenna tuning circuit with few tracking errors can be used, an interference

property becomes good. Furthermore, since an antenna tuning circuit can be prepared, it becomes easy, and matching is strong to an interference and can consider as a high sensitivity receiver. Moreover, since an antenna tuning circuit can be prepared, even if a junction type transistor constitutes the high frequency amplifier of the next step, it can make NF small enough, therefore can on-chip-ize high frequency amplifier in IC at other circuits and one.

[0120] Furthermore, PLL for local oscillation of every receiving band is almost equal in the variability region of the oscillation frequency of VCO then, or since the variability region in a certain receiving band can be included in the variability region of other receiving bands, it needs neither VCO nor a property special as the resonance circuit nor the thing of a configuration, while being able to use it common to two or more receiving bands.

[0121] Moreover, since dividing of the oscillation signal formed of VCO was carried out to 1/n on the good variations circumference way and the local oscillation signal has been acquired, phase noise of a local oscillation signal can be made small corresponding to a division ratio n. Therefore, it is digital broadcasting, and when receiving the broadcast wave signal accompanied by a phase modulation, it can consider as a more suitable receiver. Furthermore, since it is not necessary to prepare the nonvolatile memory which memorizes the data for alignment of an antenna tuning circuit, or to make nonvolatile memory memorize in quest of the data for alignment the whole set of a receiver, manufacture can take neither time and effort nor time amount, but the rise of cost can be suppressed.

[0122] Furthermore, although the frequency band (150kHz - 30MHz) from long wave band to a short wave band is receivable, since it is good at one PLL, it is advantageous to IC-izing. And since an antenna tuning circuit and all the circuits except the resonance circuit of PLL can be mounted in IC, a multi-band receiver with few external components can be offered cheaply. Furthermore, since the oscillation frequency of VCO32 turns into a frequency far higher than a receiving band, even if the oscillation signal of VCO is received by the antenna, it can prevent with an easy low pass filter, and is hard to generate reception active jamming.

[0123] Moreover, in a mixer circuit, even if it produces spurious active jamming by the higher harmonic of a local oscillation signal, the signal component which does the spurious active jamming with a low pass filter can be prevented. And a property can be improved, without increasing components mark and the time and effort of adjustment by building a low pass filter in IC then. Moreover, since the frequency of an intermediate frequency signal is low, when carrying out digital processing of the next signal from this intermediate frequency signal, this becomes possible easily.

[0124] Furthermore, since the intermediate frequency is low, while being able to carry out [on chip]-izing of the band pass filter which chooses the intermediate frequency signal to IC, a required crystal filter becomes unnecessary with the receiver of a double conversion mold, and cost can be lowered. Moreover, since the height ratio of the oscillation frequency of VCO of PLL becomes about two in every receiving band by changing division ratios N and n, it can consider as a good tracking property. Furthermore, components mark can be reduced and the receiver of a multi-band can be realized with a very simple configuration.

[Translation done.]

CLAIMS

[Claim(s)]
[Claim 1] In the receiver of the superheterodyne system which uses the 1st frequency band and 2nd frequency band as a receiving band at least A variable frequency oscillator circuit and the good variations circumference way which the oscillation signal of this variable frequency oscillator circuit is supplied, and carries out dividing of this oscillation signal, It has a mixer circuit for carrying out frequency conversion of the input signal to an intermediate frequency signal with a local oscillation signal. The dividing output of the above-mentioned good variations circumference way is supplied to the above-mentioned mixer circuit as the above-mentioned local oscillation signal. At the time of reception of the 1st frequency band of the above By changing the division ratio n of the above-mentioned good variations circumference way, and the oscillation frequency of Above VCO, the received frequency in the 1st frequency band of the above is changed. At the time of reception of the 2nd frequency band of the above The receiver which changed the received frequency in the 2nd frequency band of the above by changing the oscillation frequency of Above VCO at least.
[Claim 2] It is the receiver which changed the oscillation frequency of Above VCO by setting the above-mentioned variable frequency oscillator circuit to VCO in PLL in a receiver according to claim 1, and changing the division ratio N of the good variations circumference way in Above PLL.
[Claim 3] The receiver which amended the tracking error by changing the above-mentioned division ratios n and N at the time of reception of one frequency band if it has the antenna tuning circuit of the electronic tuning method which chooses and takes out the above-mentioned input signal in a receiver according to claim 2, the control voltage supplied to Above VCO is supplied to the above-mentioned antenna tuning circuit as tuning voltage and there are few 1st frequency bands of the above and 2nd frequency bands.
[Claim 4] The receiver with which it was made for the height ratio (ratio of the highest frequency and lowest frequency) in the 1st frequency band of the above and the height ratio in the 2nd frequency band of the above to become almost equal in a receiver according to claim 3.
[Claim 5] The receiver which removes the frequency component of 3 times or more of

the above-mentioned received frequency with the above-mentioned adjustable low pass filter by changing the cut off frequency of the above-mentioned adjustable low pass filter corresponding to received frequency, and eliminated the spurious interference by the oddth higher-harmonic signal of the above-mentioned oscillation signal while having an adjustable low pass filter in the preceding paragraph of the above-mentioned mixer circuit and setting the height ratio in each frequency band about to two in the receiver according to claim 4.

[Claim 6] The receiver which changed the cut off frequency of the above-mentioned adjustable low pass filter in the receiver according to claim 5 according to the data for setting the above-mentioned division ratio N as the good variations circumference way of Above PLL.

[Claim 7] The above-mentioned oscillation signal is made into one pair of oscillation signals with which 90 degrees of phases differ mutually in a receiver according to claim 1 to 6, the above-mentioned mixer circuit is made into one pair of mixer circuits to which the one above-mentioned pair of oscillation signals are supplied, respectively, and they are a phase and the receiver which carries out data processing and acquired the above-mentioned intermediate frequency signal about the output signal of one pair of these mixer circuits.

[Claim 8] In IC which constitutes the receiving circuit of the superheterodyne system which uses the 1st frequency band and 2nd frequency band as a receiving band at least The RF amplifier with which the input signal outputted from an antenna tuning circuit is supplied, The filter circuit which chooses the above-mentioned input signal from the output signal of this RF amplifier, One pair of mixer circuits for carrying out frequency conversion of the above-mentioned input signal chosen by this filter circuit to one pair of intermediate frequency signals with one pair of local oscillation signals, The one above-mentioned pair of intermediate frequency signals A phase and the processing circuit which carries out data processing and outputs an original intermediate frequency signal component, A frequency is equal in the oscillation signal of VCO which constitutes PLL and this PLL. The good variations circumference way which carries out dividing to one pair of dividing signals with which 90 degrees of phases differ mutually is formed into 1 chip. The one above-mentioned pair of dividing signals are supplied to the one above-mentioned pair of mixer circuits as the one above-mentioned pair of local oscillation signals. At the time of reception of the 1st frequency band of the above By changing the division ratio of the good variations circumference way which constitutes the division ratio n of the above-mentioned good variations circumference way, and Above PLL IC which changed the received frequency in the 2nd frequency band of the above by changing the received frequency in the 1st frequency band of the above, and changing the division ratio of the good variations circumference way which constitutes Above PLL at least at the time of reception of the 2nd frequency band of the above.

[Translation done.]